

beam at a plurality of times.

136. (New) The method according to claim 11 wherein said laser beam is a pulsed laser beam and said substrate is moved in a stepwise manner.

137. (New) The method according to claim 113 wherein said laser beam is a pulsed laser beam and said substrate is moved in a stepwise manner.

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138. (New) The method according to claim 114 wherein said laser beam is a pulsed laser beam and said substrate is moved in a stepwise manner.

139. (New) The method according to claim 118 wherein said laser beam is a pulsed laser beam and said substrate is moved in a stepwise manner.--

REMARKS

The undersigned wishes to thank the Examiner for the courtesies extended in the personal interview of October 10, 2002.

Claims 1-4, 6-9, 11-14, 16 and 17-109 were pending in this application. By this amendment, claims 1, 6 and 11 are further amended as discussed in the above-referenced interview, but continue to substantially include the limitations set forth in the Supplemental Amendment of August 30, 2002. Hence, Applicant respectfully submits that the rejections of paragraphs 1-7 of the Office Action dated August 10, 2001 should be withdrawn by the Examiner. Claims 110-139 are also added to recite features similar to those recited in claims 1, 6 and 11, and, thus, should be considered in this case. Claims 14 and 16 are canceled. As a result, claims 1-4, 6-9, 11-13 and 17-139 are currently pending in the instant application.

Addressing the rejections remaining in paragraphs 8-14 of the Office Action of August 10, 2001, claims 1-4, 6-9, 11-14 and 16 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 5-15 of U.S. Patent No. 4,786,358 to Yamazaki et al. in view of U.S. Patent No. 4,680,855 to Yamazaki et al. and Japanese Patent No. 403024259 to Toshiba KK or European Patent Application No. 209131 to

NEC Corp. or Japanese Patent document 2,174,123 to NEC Corp. or U.S. Patent No. 4,915,981 to Traskos et al. or U.S. Patent No. 4,444,801 to Hongo et al. or U.S. Patent No. 4,784,963 to Krimmel et al.

Further, claims 1-4, 6-9, 11-14 and 16 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 5-15 of U.S. Patent No. 4,786,358 to Yamazaki et al. in view of Japanese Patent No. 403024259 to Toshiba KK or European Patent Application No. 209131 to NEC Corp. or Japanese Patent document 2,174,123 to NEC Corp. or U.S. Patent No. 4,915,981 to Traskos et al. or U.S. Patent No. 4,444,801 to Hongo et al. or U.S. Patent No. 4,784,963 to Krimmel et al.

It is respectfully requested that these rejections be held in abeyance until the rejections discussed in detail below relating to the Japanese Hongo et al. reference are addressed and overcome. As discussed in the interview, once otherwise allowable claim language is agreed upon with the Examiner in this case, the above noted rejections can be reviewed in greater detail, since additional claim amendments to overcome the rejections noted below could render the above obviousness type double patenting rejections moot.

Amended claim 1 recites a method for treating an object with a laser comprising the steps of emitting a laser beam from the laser having a first cross section and expanding the laser beam in a first direction so as to increase a first cross-sectional dimension of the laser beam to form an expanded laser beam wherein the expanded beam has a second cross section. A portion of the expanded laser beam is then removed through a mask to form a masked laser beam. The portion includes at least edges of the expanded laser beam extending in the first direction. Next, the masked laser beam is condensed in a second direction orthogonal to the first direction after removing the portion wherein the beam has a third cross section. The object is then scanned with the condensed laser beam in a direction orthogonal to the first direction.

Amended claim 6 is similar to claim 1, but also recites that a length of the third cross section in the first direction is longer than a width of the third cross section in the direction orthogonal to the first direction, and the length of the third cross section in the first direction is longer than a length of the first cross section in the first direction and the width of the third cross section in the second direction is smaller than the width of the first cross section in the second direction.

Amended claim 11 is similar to claim 1, but also recites the formation of a semiconductor film and crystallization thereof by the laser beam.

Claims 1, 3, 4, 6, 8, 9, 11, 13, 14 and 16 are rejected under 35 U.S.C. § 102(b) as being clearly anticipated by the translation of JP 57-94482 to Hongo et al. This rejection is traversed for the reasons advanced below.

Hongo et al. ('482) does not appear to disclose scanning an object with a condensed laser beam in a direction orthogonal to the recited first direction. Instead, Hongo et al. ('482) contemplates a beam that is oriented in a manner perpendicular to the beam of the present invention. As a result, the presently claimed invention is patentably distinguishable over the Hongo et al. ('482) patent.

Specifically, amended claim 1 recites the shape of the laser beam and the scanning direction of object with respect to the laser beam shape which distinguishes the present invention over the cited reference to Hongo et al. ('482). Claim 6 recites the scanning direction of the object with respect to the laser beam, as well as the fact that the length of the laser beam after condensing is longer than the length of the laser beam after emission, and the width is smaller after condensing than after emission. Claim 11 recites the scanning direction feature of the present invention, as well as use of the laser beam to crystallize a semiconductor film. The advantages of the line-shaped laser beam positioned in the manner of the present invention, particularly in combination with the additional features noted above, are not disclosed in Hongo et al. ('482). As a result, claims 1, 3, 4, 6, 8, 9, 11, and 13 are not properly rejected under Section 102.

Claims 2, 7 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Hongo et al. ('482). For the reasons set forth above with respect to Hongo et al. ('482), claims 2, 7 and 12 should be considered allowable over the cited prior art.

Claims 1-4, 6-9, 11-14 and 16 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 5-15 of U.S. Patent No. 4,786,358 to Yamazaki et al. in view of Hongo et al. ('482). For the reasons advanced above with respect to Hongo et al. ('482), this rejection should be reconsidered and withdrawn.

Claims 1-4, 6-9, 11-14 and 16 are also rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-44 of U.S. Patent No. 6,149,988 to Shinohara et al.

The claims of the '988 patent do not recite expanding, removing a portion with a mask, and then condensing the masked laser beam in a second direction, as recited in claims 1, 6, and 11, particularly, as note recited in these claims as further amended herein. As a result, this rejection should be reconsidered and withdrawn.

Claims 1-4, 6-9, 11-14 and 16 are further rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-10 of U.S. Patent No. RE 33,947 to Shinohara et al. For the reasons advanced above with respect to other remaining obvious-type double patenting rejections, it is requested that these rejections be deferred until the prior art rejections are overcome.

Further, Applicant would like to note again the addition of new claims 17-109. The features of these new claims reside in the combination of a line-shaped laser beam and the use of an ion blocking film. The use of a line-shaped laser beam is very advantageous for treating a large area substrate (such as a glass substrate) for improving productivity. However, such a large substrate generally includes alkali ions. Therefore, the combination of a line-shaped laser beam and an ion blocking film for blocking alkali metals from the substrate is very advantageous for treating a large area substrate. Such an ion blocking film also permits the use of less expensive substrates. Please note that these new independent claims do not recite the use of a mask for removing a peripheral portion of the laser beam. To assist the Examiner, the new claims 17-60 are generally directed to a laser processing method while the new claims 61-96 are directed to a method of manufacturing an active matrix display device.

In addition, new claims 110-123 are added to recite additional features of the present invention to which Applicants are entitled. Specifically, new claims 110-112 recite that first, second and third cross sections of the laser beam recited in claims 1, 6 and 11 are rectangular in shape to further distinguish the invention over Hong et al. ('482).

New independent claim 113 is similar to claim 6, with the addition of the crystallization feature, independent claim 114 relates to the use of a mask and crystallization generally, and independent claim 118 relates to the use of a mask, crystallization and the laser shape/dimensions. The use of the mask is advantageous for obtaining a laser beam having a very narrow beam width at the irradiation surface. Such a very narrow beam width is particularly advantageous for performing a uniform lateral crystallization in the semiconductor film. Consideration and allowance of these additional claims are respectfully requested.

It should also be noted that the priority date available to many of the pending claims are different in view of the amendments and new limitations added. For example, it should be noted that the ion blocking film is not supported by the earliest priority Japanese application no. 61-229252 filed on 9/26/86 and the earliest U.S. priority application Serial No. 07/097,190 filed on 9/16/87. Instead, this features first finds support in the Japanese priority application filed on December 23, 1987 and in the corresponding U.S. priority application No. 07/288,186 filed on December 22, 1988. Moreover, the limitations relating to laser crystallization and active matrix displays are supported by the U.S. priority application No. 08/169,127 filed on filed on December 20, 1993.

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn, that claims 1-4, 6-9, 11-13 and 17-109 be allowed, that new claims 110-123 be allowed, and that the application be passed to issues.

If the Examiner believes a conference would be beneficial in expediting the prosecution of the instant application, she is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,

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MARKED-UP COPY OF AMENDED SPECIFICATION:

Page 10, fourth full paragraph continuing onto page 11:

As shown in Fig. 7(A), a non-single crystalline semiconductor film 52 such as an amorphous [silicone] silicon or solid phase crystallized silicon is formed by plasma CVD on a soda-lime glass substrate 1 having a silicon oxide or silicon nitride blocking layer 51 having a thickness of 1000-4000Å, e.g. 2000 Å on its surface. The non-single crystalline semiconductor layer 52 is substantially intrinsic but a suitable dopant species such as boron or arsenic may be added therein. Optionally, hydrogen or a halogen such as fluorine may be added to the semiconductor layer 52 as a dangling bond neutralizer. Also, the semiconductor layer 52 is 200-1500Å thick, for example, 500Å. Further, the semiconductor layer is covered by an insulating layer 59 made of silicon oxide or silicon nitride and having a thickness of [200-1500Å] 200-1500Å.

MARKED-UP COPY OF AMENDED CLAIMS

1. (Three Times Amended) A laser irradiation method [for treating an object with a laser] comprising [the steps of]:

emitting a laser beam [from the laser] wherein said laser beam has a first cross section;

expanding the first cross section of said laser beam in a first direction [so as to increase a first cross-sectional dimension of said laser beam] to form an expanded laser beam wherein said expanded laser beam has a second cross section;

removing a [peripheral] portion of said expanded laser beam through a mask to form a masked laser beam, said [peripheral] portion including at least edges of said expanded laser beam extending in said first direction; and

condensing said masked laser beam in a second direction orthogonal to said first direction after removing said [peripheral] portion [so as to decrease a second cross-sectional dimension of said masked laser beam] to form a condensed laser beam, [said second cross-sectional dimension being orthogonal to said first cross-sectional dimension and] said condensed laser beam having a [line-shaped transverse cross-section at the object] third cross section;

scanning an object with the condensed laser beam in a direction orthogonal to the first direction,

wherein a length of the third cross section in said first direction is longer than a width of the third cross section in said direction orthogonal to the first direction.

6. (Twice Amended) A laser irradiation method [for treating an object with a laser] comprising [the steps of]:

emitting a [rectangular-shaped] laser beam [from the laser] wherein said laser beam has a first cross section;

expanding the first cross section of said laser beam in a first direction [so as to increase a first cross-sectional dimension of said laser beam] to form an expanded laser beam wherein said expanded laser beam has a second cross section;

removing a [peripheral] portion of said expanded laser beam through a mask to form a masked laser beam, said [peripheral] portion including at least edges of said expanded laser beam extending in said first direction; and

condensing said masked laser beam in a second direction orthogonal to said first direction after removing said [peripheral] portion [so as to decrease a second cross-sectional dimension of said masked laser beam] to form a condensed laser beam, [said second cross-sectional dimension being orthogonal to said first cross-sectional dimension and] said condensed laser beam having a [line-shaped transverse cross-section at the object] third cross section;

scanning an object with the condensed laser beam in a direction orthogonal to the first direction,

wherein a length of the third cross section in said first direction is longer than a width of the third cross section in said direction orthogonal to the first direction, and

wherein the length of the third cross section in the first direction is longer than a length of the first cross section in the first direction, and the width of the third cross section in the second direction is smaller than the width of the first cross section in the second direction.

11. (Three Times Amended) A method [for treating an object with a laser] comprising [the steps of]:

forming a semiconductor film over a substrate;

emitting a laser beam [from the laser] wherein said laser beam has a first cross section;

expanding the first cross section of said laser beam in a first direction [so as to increase a first cross-sectional dimension of said laser beam] to form an expanded laser beam wherein said expanded laser beam has a second cross section;

removing a [peripheral] portion of said expanded laser beam through a mask to form a masked laser beam, said [peripheral] portion including at least edges of said expanded laser beam extending in said first direction;

condensing said masked laser beam in a second direction orthogonal to said first direction [so as to decrease a second cross-sectional dimension of said masked laser beam] to form a condensed laser beam after removing said portion, [said second cross-sectional dimension being orthogonal to said first cross-sectional dimension and] said condensed laser beam having a [line-shaped transverse cross-section at the object] third cross section; [and]

[changing the relative location of said object with respect to said laser beam so that said object is scanned with said laser beam] irradiating said semiconductor film with the condensed laser beam to crystallize said semiconductor film; and

scanning the semiconductor film with the condensed laser beam in a direction orthogonal to the first direction,

wherein a length of the third cross section in said first direction is longer than a width of the third cross section in said direction orthogonal to the first direction.